



Use of major dietary iodine sources in married student households
by Elizabeth Kathleen Divers Jacobs

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
MASTER OF SCIENCE in Home Economics

Montana State University

© Copyright by Elizabeth Kathleen Divers Jacobs (1970)

Abstract:

A survey was conducted to investigate the extent of iodized salt usage, reasons for the purchase of iodized or uniodized salt, from what sources information concerning the use of iodized salt is obtained, and the frequency with which fish, marine and shell, are served in households in the married student housing at Montana State University, Bozeman. Structured interviews were conducted with 66 household members responsible for choosing the food their families purchased.

Survey results showed that 72.7% of the households use iodized salt, and 83.3% have fish served at least twice a month. Uniodized salt was used and fish was served less than twice a month in 9.1% of the households. Over half of the respondents (54.5%) use iodized salt because it is better for their health, and 42.4% chose the type of salt they bought by picking up the first package they saw-. Mothers were the source of knowledge about iodized salt usage for the highest percentage of household members (43.6%), with schools a close second (40.0%).

It was concluded that a state-wide medical survey of goiter enlargement in Montana would be valuable to justify programs to increase iodized salt usage, such as education of mothers and school children.

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Elizabeth Kathleen Owens Jacobs
Signature _____

Date August 14, 1970

USE OF MAJOR DIETARY IODINE SOURCES IN
MARRIED STUDENT HOUSEHOLDS

by

ELIZABETH KATHLEEN DIVERS JACOBS

A thesis submitted to the Graduate Faculty in partial
fulfillment of the requirements for the degree

of

MASTER OF SCIENCE

in

Home Economics

Approved:

Maryjane Kaiser by Angelina Okato
Head, Major Department

Andrea L. Lagenkopf
Chairman, Examining Committee

J. Goering
Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

December, 1970

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to Dr. Andrea Pagenkopf, my advisor, for her guidance, support, and patient advice throughout my graduate studies; to Dr. Marjorie Keiser for her guidance with my thesis.

My thanks is also given to those married students who so kindly participated in my study by giving their valuable time for an interview.

I am grateful to my husband, Mr. Donald Jacobs, for his patience with a wife with whom it was sometimes difficult to get along; to my parents, Mr. and Mrs. Reginald Divers, for the use of their cool basement in which I could write my thesis in comfort and with privacy.

TABLE OF CONTENTS

	PAGE
VITA	ii
ACKNOWLEDGEMENTS	iii
ABSTRACT	viii
CHAPTER I. INTRODUCTION AND PURPOSES	1
CHAPTER II. REVIEW OF LITERATURE	3
The Metabolic Need for Iodine by Humans	3
Use of Iodine by the Thyroid Gland	3
Consequences and Prevention of Iodine Deficiency	7
Effects of Excessive Iodine Intake	17
Dietary Requirements for Iodine by the Body	18
Balance Studies on Iodine Intake	18
Recommended Intake of Iodine	18
Sources of Iodine in the United States of America	19
CHAPTER III. METHOD	22
Survey Instrument	22
Sampling Procedure	23
Survey Method	24
Survey of Grocery Stores	25
Treatment of Data	25
CHAPTER IV. RESULTS AND DISCUSSION	26
Characteristics of the Sample	26
Salt Usage	26
Fish Consumption	34

CHAPTER V. SUMMARY, CONCLUSIONS, RECOMMENDATIONS .	37
Summary of Method and Results	37
Conclusions	38
Recommendations for Further Study	39
APPENDIX A. SURVEY INTERVIEW QUESTIONNAIRE	41
APPENDIX B. INTERVIEW ANSWER SHEET	44
APPENDIX C. LETTER OF INTRODUCTION	45
APPENDIX D. TOTAL SAMPLE TALLY SHEET	46
APPENDIX E. TALLY SHEETS FOR AGE GROUPS	47
16-20 Years	47
21-25 Years	48
26-30 Years	49
31-50 Years	50
LITERATURE CITED	51

LIST OF TABLES

TABLE	PAGE
1. Recommended Daily Dietary Allowances for Iodine	20
2. Respondents' Source of Knowledge About Iodized Salt	33
3. Frequency Fish is Served in Households Using Iodized or Uniodized Salt	36

LIST OF FIGURES

FIGURE	PAGE
1. The Thyroid Body	5
2. The Follicles of a Human Thyroid	5
3. Goiter Belts of the United States of America	12
4. Age Distribution of the Sample	27
5. Percentage of Households with Members on Special Diets	27
6. Percentage of Families Using Salt Other Than at the Table or During Cooking	28
7. Percentage of Households Using Iodized or Uniodized Salt for Various Purposes	28
8. Households Using Iodized Salt Compared to Those Which Have Heard of Using Iodized Salt	30
9. Reasons for Purchase of Type of Salt Used	30
10. Percentage of Households Serving Fish at Various Frequencies	35

ABSTRACT

A survey was conducted to investigate the extent of iodized salt usage, reasons for the purchase of iodized or uniodized salt, from what sources information concerning the use of iodized salt is obtained, and the frequency with which fish, marine and shell, are served in households in the married student housing at Montana State University, Bozeman. Structured interviews were conducted with 66 household members responsible for choosing the food their families purchased.

Survey results showed that 72.7% of the households use iodized salt, and 83.3% have fish served at least twice a month. Uniodized salt was used and fish was served less than twice a month in 9.1% of the households.

Over half of the respondents (54.5%) use iodized salt because it is better for their health, and 42.4% chose the type of salt they bought by picking up the first package they saw. Mothers were the source of knowledge about iodized salt usage for the highest percentage of household members (43.6%), with schools a close second (40.0%).

It was concluded that a state-wide medical survey of goiter enlargement in Montana would be valuable to justify programs to increase iodized salt usage, such as education of mothers and school children.

CHAPTER I
INTRODUCTION AND PURPOSES

Introduction

Goiter is not a new disease: references to a swelling of the neck go back to the Chinese in the second millenium B.C. (1). There have therefore been reports of goiter for many centuries, but that does not mean the disease is no longer a problem: preliminary results of the 1968 National Nutrition Survey, conducted by the United States Public Health Service's Nutrition Program, indicate a 5% incidence of enlarged thyroids, or goiter (2).

Retardation, both physical and mental, occurs when generations are subjected to iodine deficiency (3). Bozeman, Montana, has extremely small amounts of iodine in its water supply (4), and a concomitant lack of iodine in the soil. There is little iodine to be found, therefore, in the food produced in the Bozeman area, so other sources of iodine must be used. Iodized salt and marine or shellfish are the two major nutritional sources of iodine (3).

Purposes

This study was undertaken to investigate the following trends among students living in married student housing at Montana State University: (1) the extent of iodized salt usage; (2) reasons for the purchase of iodized or uniodized salt; (3) from what sources information concerning the use of iodized salt is obtained; and (4) the frequency with which fish, marine and shell, are served. It was hoped that these trends would lead to conclusions regarding the following possibilities: (a) whether a state-wide goiter survey in Montana would be of value; and (b) if education on purposes and methods of goiter prophylaxis is necessary.

CHAPTER II

REVIEW OF LITERATURE

Before a discussion of the survey that was conducted, this chapter will present some background information about why there is a need for iodine by the human body and how much iodine is required. It is important to know how the body uses iodine, what may be the consequences of an iodine deficiency, and what methods are available for preventing these deficiency diseases, for they are rarely cured once they are well established in a human (1).

The Metabolic Need for Iodine by Humans

Use of Iodine by the Thyroid Gland

Iodine is essential in the manufacture of thyroid hormones, which affect a human's rate of growth and development. Thyroid hormones are produced in the thyroid gland.

The Thyroid Gland

In 1965 Wilson et al wrote: "All tissues and secretions of the body thus far analyzed have been found to contain iodine" (3: 167). Of the 20-50 milligrams of iodine found in the human body, however, 20-40% of it is located in the thyroid gland (5). The name "thyroid," which means "shield-shaped," was given to the gland in 1656 by Thomas Wharton (1,6). Figure 1 illustrates the placement of the thyroid

with respect to a human's trachea, or windpipe. Fibrous connective tissue supports and creates a framework for the gland. The active, functional tissue consists of a number of follicles which resemble the sacs of an orange section, except for being spherical and microscopic. Epithelial cells of the follicle wall manufacture thyroid hormones (Figure 2). A colloid fluid in the center of the cell stores the hormones (6).

Biosynthesis and metabolism of thyroid hormones

The biosynthesis and metabolism of thyroid hormones is a complex process that is not yet fully understood. Baumann, in 1895 (5) or 1896 (1), first demonstrated that iodine was a normal constituent of the thyroid gland. Iodine is consumed in organic or inorganic food forms, and readily absorbed into the blood stream from the small intestine (3). The blood ionizes iodine (I_2) to iodide (I^-). Iodide is the chemical form in which the mineral is transported from the blood into the thyroid gland (7,8,9,10). Iodide is then concentrated and stored in the colloidal matter of the thyroid cell (3,9,10). When the need for thyroid hormones arises, iodine is removed from storage and combined with thyroglobulin, a protein (3,8,9,10).

Thyroxine is the most abundant thyroid hormone. It is eventually formed by the addition of iodine to tyrosine, an amino acid, within the thyroglobulin molecule. Enzymes then release thyroxine from the

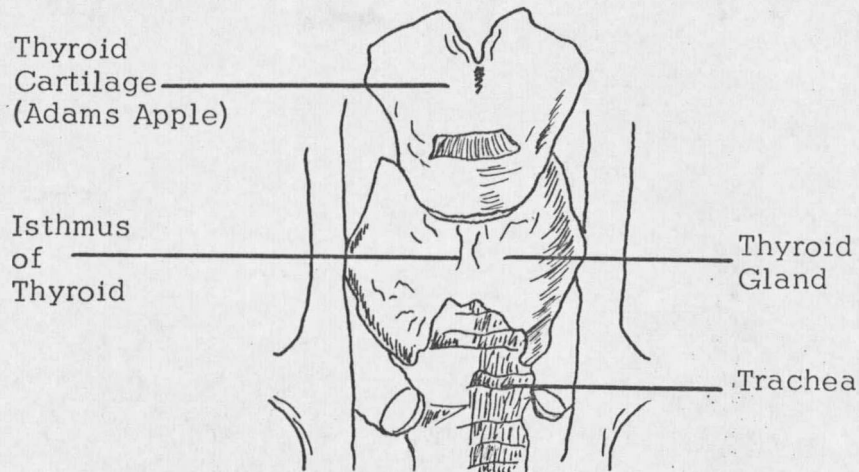


Figure 1--The Thyroid Body
(Sebrell, W. 1949. Iodine--a food essential. Pub. Health Rep. 64: 1077)

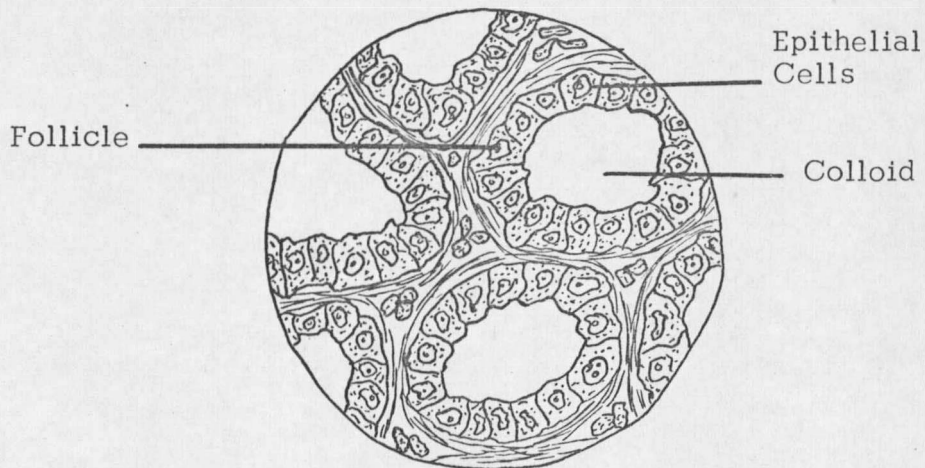


Figure 2--The Follicles of a Human Thyroid
(Sebrell, W. 1949. Iodine--a food essential. Pub. Health Rep. 64: 1077)

protein, and it is transported into the blood (8,9,10). There are three proteins that carry thyroxine in the blood to body tissues (11,12).

The catabolism of thyroxine exemplifies the body's ability to conserve its important constituents. While the breakdown of thyroxine usually begins in the liver, the kidney and muscle tissues may also initiate catabolism (12,13). The liver releases thyroxine from its carrier protein and secretes it into the intestines by way of the bile. Ninety-seven per cent of the thyroxine that reaches the small bowel is reabsorbed into the blood (12). This conservation of thyroxine means the thyroid gland only has to replace three per cent of the thyroxine it secretes.

Functions of thyroid hormones.

"Investigating the mechanism of action of the thyroid hormones is somewhat like peeling the successive layers of an onion. Not only may it bring tears to the eyes, but after each successful step, one is left with the layer beneath" (14: 267). A discussion of how the thyroid hormones perform their functions is not, therefore, within the limitations of this study; what happens when thyroid hormones are or are not present will be discussed.

The major functions of thyroxine involve rates of energy metabolism and growth and development. Oxidation rates in the cells of a human body are affected by thyroxine levels (3,14). An increase in thyroxine secretion increases energy metabolism, and therefore basal

metabolic rate (3). Normal development at puberty is also dependent on proper thyroid function (15). A deficiency of thyroxine causes sterility in animals (3), and improper fetal growth in humans (16).

Consequences and Prevention of Iodine Deficiency

Simple and toxic goiter

The formation of a goiter is a mechanism by which the thyroid compensates for a lack of iodine (3). An iodine deficiency results in a lower level of thyroxine in the blood, sensitizing the pituitary gland, which activates the thyroid (17). A decrease in blood thyroxine, therefore, stimulates the thyroid. It enlarges to become more efficient, forming a goiter (3,17,18). Chatin, in the late nineteenth century, found a correlation between a lack of iodine intake and goiter (1). After Baumann's discovery of iodine in the thyroid, and a demonstration by Hopkins in 1912 that disease could be caused by a lack of trace elements, Chatin's theory was accepted.

Stages of goiter formation. --There are three stages of simple goiter, the last of which may eventually lead to toxic goiter. When there is a low iodine intake, the colloid center of thyroid follicles contains less iodine (6). The cells then increase in number and size to compensate. Parenchymatous goiter is the first stage (6). The thyroid's epithelial cells multiply abnormally (hyperplasia) when the iodine content of the thyroid goes below 0.1% (15). The result is a

hard, symmetrical goiter. Multiplication of the cells may continue until exhaustion, or it will stop and the follicles fill with colloidal matter. At this second stage the goiter is colloidal in nature, and very soft (6). The iodine content of the gland may be adequate for a thyroid of normal size, but there is not enough for the thyroid's increased size. After a first or second stage goiter, an adenomatous goiter may form (6). Adenomas are asymmetrical and uneven. They usually occur after thirty years of age in humans. After fifteen years of an adenomatous goiter, a toxic goiter may develop (6): the thyroid becomes hyperactive, so the thyroid hormones are present in the blood at toxic levels. Thyrotoxicosis can be fatal.

Etiology. --There are several etiological factors in simple or endemic goiter: dietary iodine deficiency, goiter-producing agents, or goitrogens in the diet, excessive intakes of calcium or fluorine, and heredity (19). A deficient intake of iodine may be absolute or relative (20,21). Absolute deficiency is the result of a very low dietary intake, whereas excess requirements for iodine by the body will cause a relative deficiency of iodine (21).

A low dietary intake of iodine may not be solely due to a bad choice of food sources. The physical environment of the area in question can be a large factor. Foods produced in certain areas of the world contain little or no iodine, as a result of low iodine levels in

the soil and water (20). After the last Ice Age, glaciers receded, sweeping away the iodine-rich soil. Then a process of replenishing the soil began, usually by air-borne iodine from the sea. It has been found that the shorter an area's post-glacial period, the greater the likelihood of endemic goiter (20). Areas with a great deal of rain and flooding lose soil iodine; cropping also depletes the soil's iodine content (20).

Soil and water content are not the only physical factors that limit dietary intake of iodine. A cold climate will indirectly influence the prevalence of endemic goiter as a result of an increased demand for thyroid hormones to regulate the body's metabolic rate (20). Iodine intake may not be sufficient to supply this increased requirement for thyroid hormones. Variations in sunlight and rainfall have been suggested as a factor that influences the goitrogenic properties of some foods (20). Proximity to the sea may also be important in the availability of sea foods, which have a high iodine content (20).

Inhabitants of some areas of goiter endemicity consume a very monotonous diet, which may be part of their cultural heritage. If the food is produced in an area with very little natural iodine, their diet will be deficient in this element (20).

Dietary intake of iodine may be adequate, and its absorption normal; yet thyroid enlargement will still occasionally occur. Extensive research has been done on goiter-producing agents in food (22).

Goiter has been produced in rabbits fed cabbage diets (3). Blum suggested that the goitrogen in cabbage may inhibit reactions in the liver that supply iodine to the thyroid gland (22). Clements and Wishart investigated possible reasons for the failure of a goiter prophylactic attempt with Belgian children (23). They found that dairy cows were consuming an uncooked forage, chou-moellier, that was known to contain a goitrogen. This forage was from the Cruciferae brassica family which also contains cabbage (23). The presence of a goitrogen in vegetable oils has been suggested: rats fed these oils had increased iodine requirements. Other foods that may contain goitrogens are: cauliflower, turnips, Brussel sprouts, kale (2), rutabaga, filbert nuts, walnuts, canned baked beans, string beans, and peas (25). Ground-nuts or peanuts (26), peaches, pears, strawberries, spinach, carrots, and perhaps soybeans are a few more of the many possible goitrogen-containing foods (20).

Under certain conditions, there is an increased need for iodine by the body (21,26). If iodine intake does not meet these excess requirements, a deficiency will result (27). During fetal life, puberty, pregnancy, lactation, and menopause, "Growth, differentiation, and energy transformations are the greatest" (27: 1463). These periods are when goiter most frequently develops. Other factors which may increase the body's need for iodine include infection, injury, and the presence of toxic agents in the body (27).

Excessive mineral intake and heredity are two etiological factors of goiter that have been investigated. There have been some reports of excessive calcium or fluorine intakes causing goiter in animals (19). However, Demarchi et al. found that areas in Iraq with hard water had no goiter endemicity (28). Extensive research has been performed on the factor of heredity in goiter etiology. Early conclusions indicate that heredity is a definite factor in susceptibility to thyroid enlargement (29). The inheritance of a susceptibility to goiter may differ in different families: either recessive or dominant genes, and sex-linked or non-sex-linked genes (29).

Incidence. --Incidence of goiter in certain areas of the United States is much greater than in other areas (Figure 3). In 1920 a goiter survey was made by the United States Draft Board (4). They considered goiters only so large that military collars could not be buttoned around the draftee's neck. Montana had the fourth largest ratio of goiters per 1,000 men drafted: 21.00 (4). In general, goiter is most prevalent in the Great Lakes region and the Pacific Northwest (4). Olesen compiled survey data on children in 43 states, and found a goiter incidence of ten to fifty times more than the Draft Board (4). This was mainly due to the smaller size of goiter reported by Olesen's data. A survey of 9,321 children in seven Montana counties revealed an incidence of thyroid enlargement as follows: 13.4% for boys, and 32.0% for girls (4,30,31). Goiter is usually considered to be more prevalent in

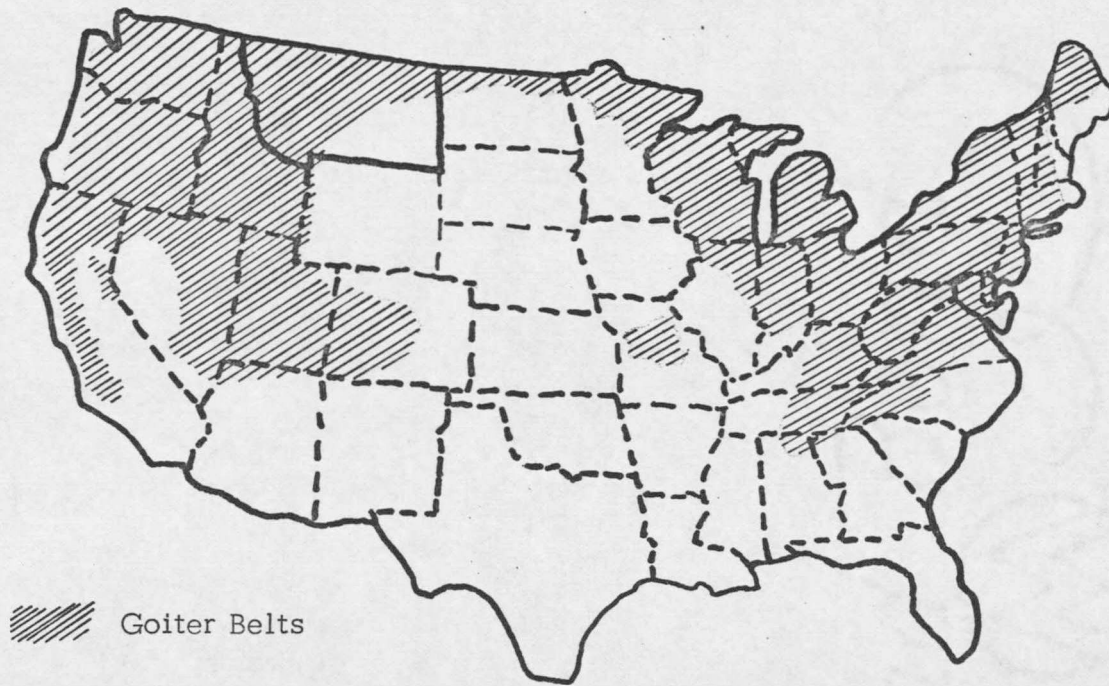


Figure 3--Goiter Belts of the United States
(Scrimshaw, N. 1964. The geographic pathology
of thyroid disease. In *The Thyroid*. J. Hazard
and D. Smith, eds. Baltimore: Williams and
Wilkins, p. 101)

the female population, due to a greater number of stress periods during the lives of females, such as pregnancy (15). Figures for comparative incidence between females and males range from 6:1 to 5:2 (4,15,27, 30,31).

Prophylactic measures.--Goiter prophylaxis is considered essential not only to prevent goiter itself, but also to prevent the complications that go with the disease (32). If a mother lacks iodine her fetus will fail to develop normally. Physical retardation can be corrected with iodine administration, but the resulting mental retardation is irreversible. There is often a need for surgical procedures in the treatment of goiter. Prophylaxis would prevent the need for these operations, with their expenses and complications (32). Goiter prophylaxis is more effective when applied as early in life as possible (33). Curtis and Fertman believe application could be decreased after puberty in males, but should continue throughout a female's reproductive years (33).

Early methods of goiter treatment and prophylaxis go back to the recommendation of seaweed by Chinese authorities (1). In the twelfth century A.D. Roger of Salerno recommended burnt sponge for goiter treatment. One of the first and most widely-used prophylactic measures in the United States was iodized salt. Hirschfelder, in 1922, wrote that the lack of iodine intake was a food deficiency, and so iodine should be supplied with a food source (34). Iodized table salt

was recommended as the most convenient long-term method of administering iodine. Hirschfelder also gave a recipe for the preparation of iodized salt by a housewife.

Knowledge that goiter was prevalent in Michigan led to a campaign for mass goiter prophylaxis (35). In 1924 Sherman recommended investigation into compulsory salt iodination as a means of goiter prevention (36). In 1924, Olin also endorsed iodized salt as the most convenient vector for iodine (35). The first concentration of iodine added to salt, used in Michigan, was 0.02% of the salt as sodium iodide (33). Marine, however, recommended a concentration of 0.005% to 0.01% sodium or potassium iodide (26). In 1949 the American Public Health Association then recommended a concentration of 0.01% potassium iodide as sufficient for prophylaxis (33). On the assumption that average salt intake was 6.2 grams per day, 474 micrograms iodine would be consumed with the recommended concentration of 0.01% potassium iodide (33).

There were some objections to the use of iodized salt. In 1928 one reported result of iodized salt intake by those people with thyroid enlargements was hyperthyroidism (37). Kimball studied the situation in humans. He found much less hyperthyroidism among those who had used iodized salt than among those who had not used any iodized salt before (37). Another objection to iodized salt was the oxidation loss of iodine that occurred during storage (38). Iodized salt for humans,

0.02%, lost forty per cent of its iodine in eighteen months (38).

Storage loss was finally cut to 0.9% of the iodine in four months by milling the potassium iodide with calcium stearate.

Iodination of salt is not always practical (39). There are several other means of goiter prophylaxis. Iodized water was a major possibility recommended by Sherman (36). In the early 1920's, Rochester, New York, intermittently iodized their water for two years (40). The iodine concentration was so low that two quarts of water had to be consumed daily by each person (40). Inhalation of a 10% iodine suspension proved to be unpopular, as dosage was variable (40). An iodide salt in a tablet or solution form had a disagreeable taste, even when mixed with lactose, milk sugar (40). Iodized chocolate tablets were used in Michigan, but were found to be cumbersome for mass prophylactic measures (40). Iodized oil injections were given to New Guinea natives in 1965 (41). Although this method did not cause any ill effects, injections are feared by many people, so the success of a mass injection program is questionable.

Extensive surveys have been conducted in Michigan and Ohio to test the effect of goiter prophylaxis with iodized salt (3). A survey was conducted in Ohio in 1925 before salt iodination, which began in 1929. Results of a resurvey in 1955 by Hamwi et al. showed that the incidence of thyroid enlargement decreased from 32.3% to 4.05% (42). Of those thyroids enlarged at all, 99.9% were only slightly enlarged.

In Cleveland Kimball found many were not using iodized salt because it was "medicated" salt (43). Another comment was that as there had been no recent publicity, the goiter "epidemic" had passed. Kimball suggested changing "iodized" salt to "enriched" salt, as some natural salt does contain iodine.

Goiter prophylaxis with iodized salt has been successful in other areas of the world. Goiter incidences of 98%, 95%, and 85% have been reduced to 32%, 30%, and 23%, respectively, in South America (44).

Other thyroid disorders

Cretinism and myxedema. --Goiter is not the only result of iodine deficiency. When antithyroid drugs are given to female mammals, their offspring exhibit signs of cretinism (16). Cretinism is a lack of normal growth and development during fetal life (6). Degeneration of the thyroid after birth is known as myxedema (6). Myxedemic humans also lack normal growth and development.

Cancer. --Ninety per cent of all cancers of the thyroid arise from goiters (26). Recently, initiation of breast cancer in female rats has been found to occur during iodine deficiency (45). Until carcinoma develops, the process is reversible, although treatment with iodine may be inhibited by sex hormones such as estrogen. Eskin therefore suggested a woman's iodine status should be checked before

estrogen treatments for contraception or post-menopause are initiated.

Effects of Excessive Iodine Intake

Effects of excessive iodine intake have been recorded. Astwood considered an intake of five milligrams daily to be excessive (32). This can be compared to the previously discussed average intake of iodine, 474 micrograms per day or one-tenth of five milligrams, by the use of iodized salt (33). In 1926 Hartsock reported the treatment of sixteen men for hyperthyroidism, which was attributed to continued use of iodized salt (46). He found a definite correlation between hyperthyroidism and the use of iodized salt in one-fourth of the aforementioned cases (46). In 1953 Morgans and Trotter reported on two cases of myxedema attributed to iodide administration (47). When the iodide-containing medication was discontinued, symptoms of myxedema disappeared. The most recent research on the subject of excessive iodine intake pointed to an autoregulatory system to prevent large uptakes of iodide by the thyroid (48,49). Socolow et al. (48) experiment with rats, and Yamamoto et al. (40) found autoregulation in humans.

Dietary Requirements for Iodine by the Body

Balance Studies on Iodine Intake

Results of iodine balance studies with healthy subjects (50), the nongoitrous with low iodine intakes (51), and pregnant females (52) showed consistent negative balances. The thyroid acquires 25-35% of ingested iodine, and the rest is excreted, mainly in the urine (10). Vought and London's study of three inpatients showed an obligatory iodine excretion, no matter how little iodine was consumed (50). Malvaux et al. studied nongoitrous children and adolescents whose iodine intakes were below 50 micrograms daily (51). Iodine excretion consistently exceeded iodine intake. It was suggested that there may be occasional days with extremely high intakes of iodine, or the thyroid would become depleted within four months (51). Dworkin et al. found no difference in iodine balance between pregnant and non-prenant females (52). There was also no difference between the ante- or post-partum months of pregnant subjects.

Recommended Intake of Iodine

In 1968 an officially recognized daily requirement for iodine was established (53). Curtis and Fertman studied iodine balance experiments, and concluded that 100-200 micrograms of iodine were required for normal thyroid activity in adults (33). In 1955 Astwood reported that the accepted daily requirement for iodine was 100-200 micrograms

(32). The Food and Nutrition Board of the National Academy of Sciences—National Research Council established iodine requirements for residents of the United States (Table 1). The Board indicated that 75 micrograms of iodine per day was the minimum amount of iodine needed by an adult (53).

Sources of Iodine in the United States of America

Non-goitrous regions

Non-goitrous regions have many sources of iodine. One of the most basic sources is water. However, some areas have become goitrous when their water supply was changed (54). When the water supply of St. George, Utah, was changed from wells and surface springs to an igneous rock source, goiter became endemic to that area (54). Sea coast areas often have a source of iodine in the sea food available (55). Vegetables and dairy products produced in iodine-rich soil often contribute more to total dietary iodine than sea food (56).

Goitrous regions

In general. --Goitrous regions must rely on iodized salt or food produced in non-goitrous regions as sources of iodine (36). Jarvis et al. recommended canned fish, especially salmon, as a source of iodine (55).

Montana. --McClendon reported that there was a level of 0.015 micrograms of iodine per kilogram of water in Bozeman, Montana

TABLE 1
RECOMMENDED DAILY DIETARY ALLOWANCES
FOR IODINE

	Age (years)		Iodine (ug)
	From	Up to	
Infants	0-1/6		25
	1/6-1/2		40
	1/2-1		45
Children	1-2		55
	2-3		60
	3-4		70
	4-6		80
	6-8		100
	8-10		110
Males	10-12		125
	12-14		135
	14-18		150
	18-35		140
	35-55		125
	55-75+		110
Females	10-12		110
	12-14		115
	14-16		120
	16-18		115
	18-35		100
	35-55		90
	55-75+		80
Pregnancy			125
Lactation			150

Source: Food and Nutrition Board, National Academy of Sciences—National Research Council. 1968. Recommended Dietary Allowances. 7th ed. Washington, D.C.: National Academy of Sciences, Publication 1694.

(29). Water is not, therefore, a very good source of iodine in Bozeman. The level of iodine reported was the fourth lowest concentration of the many cities in the country that were tabulated.

The results of a goiter survey in Montana were reported in 1929 by Olesen (32), but no data was found to indicate that a goiter survey has been conducted since then. Food transportation and packaging methods have improved since 1929, so Montana residents may be consuming enough good sources of iodine to prevent the formation of goiters. The following chapters will discuss a pilot study that was conducted to determine the need for an extensive goiter survey in Montana.

Kimball (43) mentioned that the consumer needs to be constantly educated about the need for use of iodine-rich food sources in the goiter belts. Therefore the following study will also attempt to indicate whether or not education is needed in the population that was sampled.

CHAPTER III

METHOD

Survey Instrument

A structured interview form was devised with the assistance of graduate committee members. The form (Appendix A) was used to obtain information from the member of the household concerned with food buying.

The age of the food-buyer, whether or not the family had members eating baby food and/or formula, and whether or not there were household members on a low salt diet was determined to indicate the characteristics of the sample families. Information about the use of iodized salt while dining, cooking, and pickling was obtained by the interview. The form was also used to determine reasons for use or non-use of iodized salt, if there was awareness of the practice of using iodized salt, and where or from whom information concerning the use of iodized salt was obtained. The frequency with which the housewife served ocean fish and shellfish was determined by the interview questions.

The original questionnaire was administered to ten households from the sample. As only minor revisions were necessary, these ten families were included in the sample.

An answer sheet (Appendix B) was used to mark replies to questions, as data tabulation would be easier from one page of data per household.

Sampling Procedure

An alphabetically ordered list of married student housing residents during Spring Quarter, 1970, was obtained from the Housing Office at Montana State University. A sample of 83 families, from a total of 444, was selected from this list with the use of consecutive one-digit numbers in a table of random numbers. The first number in the table was the number of the first sample household, beginning with the top of the list. For example, if the first number was three, the third family of the list was the first family sampled. Each subsequent number in the table indicated the number of families, from the last one sampled, that were counted before another household was chosen. For example, if the number six was the next one in the table, the sixth family after the one previously sampled was selected as the next sample household.

If, during the survey, it was found that the selected family had moved, and another family was in residence, the family at the residence when the interviewer made her visit was used in the sample. If the residence was vacant, it was considered a non-reply.

Survey Method

The housewife of each sample household was sent a letter of introduction (Appendix C). This letter mentioned the subject of the survey, described the circumstances under which the survey was being conducted, and asked for cooperation when the interviewer arrived.

Structured interviews were conducted with the member of the household responsible for choosing the food that the family purchased. The first visit was made during the morning hours. If the desired household member was not at home, up to two more trips were made during evening hours. If the subject still could not be reached, a maximum of two telephone calls were made to try and establish suitable hours for an interview. These telephone calls were made during the early evening. If the household could not be reached by telephone, additional visits were made to try and contact the household member.

Interviews with members of 66 households were conducted, a return of 79.5% on the original sample. Of the 17 household members that could not be interviewed, four (23.5%) were uncooperative, five (29.4%) could not be reached by personal visits or telephone calls, and eight (47.0%) had moved, leaving a vacant residence.

Survey of Grocery Stores

An informal survey was made of five grocery stores, two large and three small ones, to determine: (1) if there was any difference in price between iodized and uniodized salt; and (2) approximately how much iodized salt was sold compared to uniodized salt. The store manager, owner, or person responsible for ordering items sold by the stores, was contacted for an estimate of the sales volumes for iodized and uniodized salt.

Treatment of Data

The interview answer sheets were tallied onto summary answer sheets for the total sample (Appendix D) and for each age group (Appendix E). Because the numbers of respondents from the 31 to 40 and 41 to 50 age groups were small, these two groups were combined into one age group of 31 to 50 years.

Percentages were always used to compare data. In some instances the categories used in tabulations were such that the total number of respondents in each category was not the same, for example, the comparison of a trend between iodized and uniodized salt users. In those cases, both numbers and percentages were given.

Data is not tabulated in age categories, as analysis indicated that there were no trends that depended on the age of the respondent. Also, one age group dominated the sample (Chapter IV), so comparisons between age groups would be unrealistic.

CHAPTER IV

RESULTS AND DISCUSSION

Characteristics of the Sample

Sixty-six household members responsible for the choice of food that is purchased by their families were interviewed. The majority of respondents (62.1%) were in an age range of 21 to 25 years (Figure 4). Few households had members on special diets (Figure 5): about one-fifth (21.2%) of the households included infants eating baby food or formula, and 12.2% of the families had members on a low salt diet.

Salt Usage

A large percentage (83.3%) of the interviewees indicated that they used salt only for cooking and at the table (Figure 6); only one-fifth (21.4%) of those households with infants added salt to their infants' food; and 12.1% of the housewives in this population had canned food that required the use of salt.

Figure 7 shows the percentage of households that use iodized salt (72.7%) when cooking and eating. It should be noted that of the 27.3% that were using uniodized salt when interviewed, 3.3% said they usually used iodized salt, but had purchased the wrong kind (Appendix D). The results of this survey are comparable to those of a nationwide survey in 1957, which indicated that 76% of the households used iodized salt exclusively, 20% never used it, and 4% used it part of

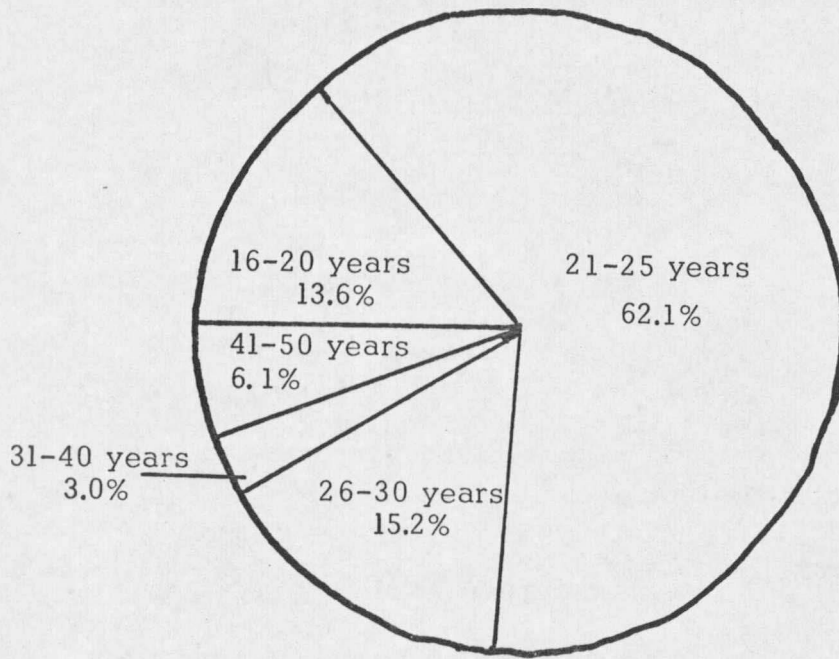


Figure 4--Age Distribution of Sample

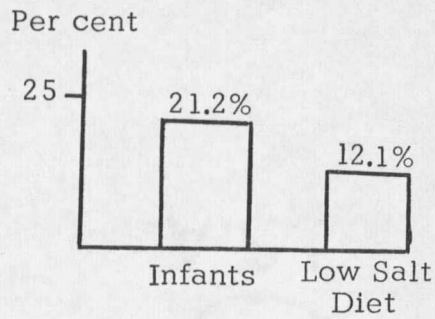


Figure 5--Percentage of Households with Members on Special Diets

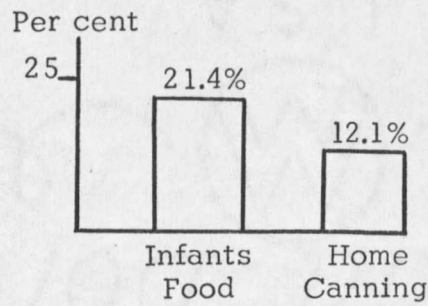


Figure 6--Percentage of Families Using Salt Other Than at the Table or During Cooking

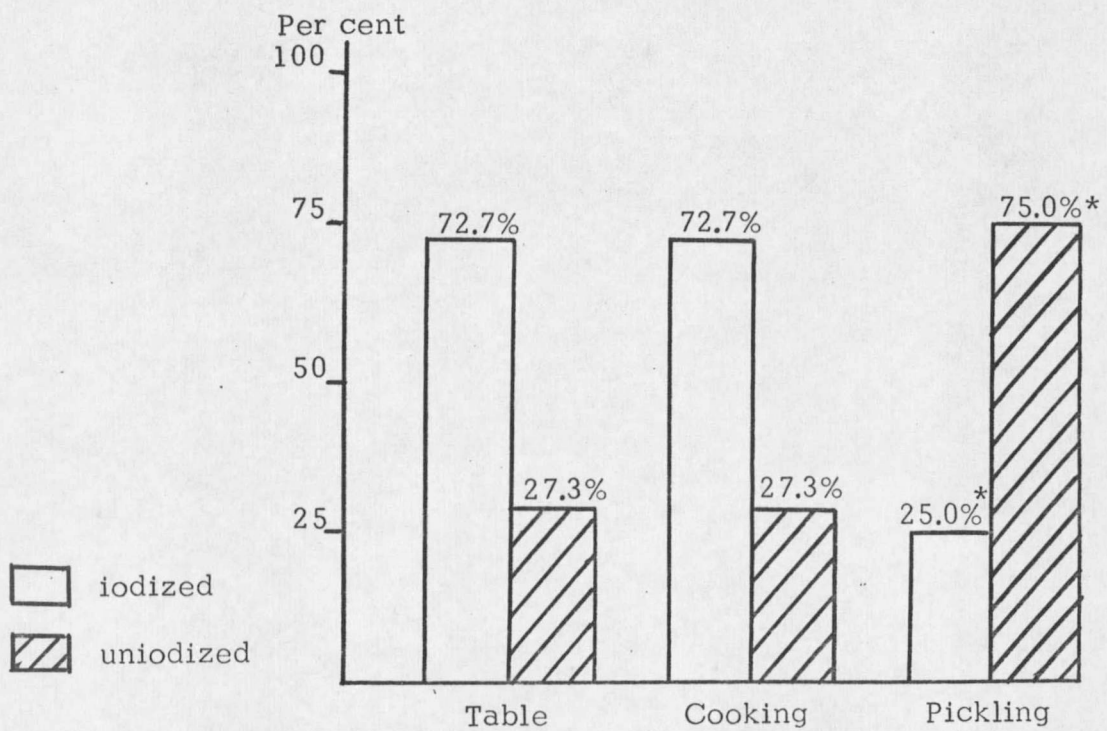


Figure 7--Percentage of Households Using Iodized or Uniodized Salt for Various Purposes

* Total number of those who pickled food is eight.

the time (3). However, the United States Department of Agriculture (57) reported that in their 1965 Household Food Consumption Survey 85% of the families that bought salt, in the week that households were surveyed, bought iodized salt. The above data points out that even though a great deal of Montana is in a goiter belt, the percentage of iodized salt users is less than that same percentage in the most recent survey of the United States.

Three-fourths of those housewives who did some canning with salt said they used uniodized salt--either table or rock salt (Figure 7). Rock salt can be bought in large bags, so when large batches of pickles are being made, it is probably the most convenient form of salt. In 1952 the need to use uniodized salt when canning was refuted by the U.S. Canner's Association, which has stated that there is no disadvantage to the use of iodized salt in all canning operations (58).

A comparison between the percentage of household members who use iodized salt (72.7%) and those who have heard of using iodized salt (80.3%) can be seen in Figure 8. That there is a discrepancy between knowledge and application of that knowledge is evident in this survey.

Although Figure 9 shows that a majority (54.5%) of those who bought iodized salt purchased it because they felt it was better for their health, there was a large percentage (42.4%) of household

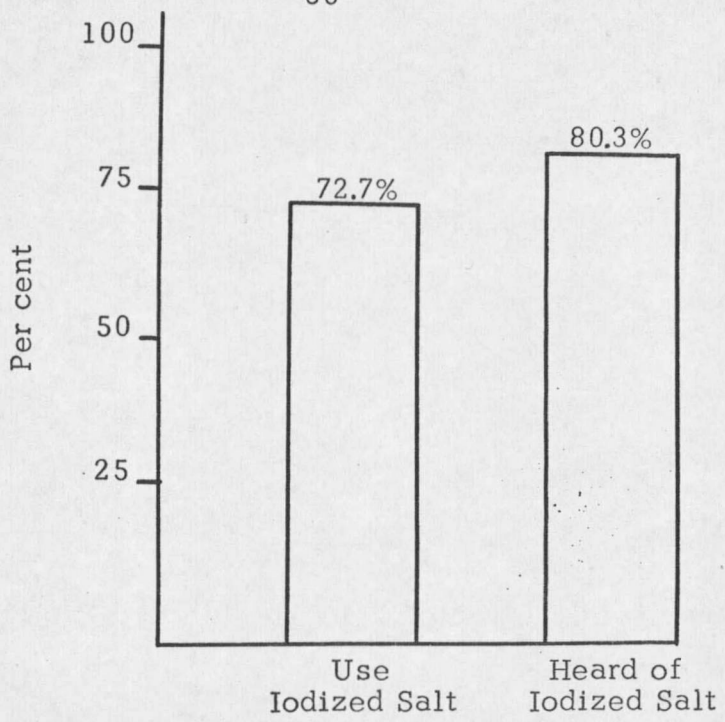


Figure 8--Households Using Iodized Salt Compared to Those Which Have Heard of Using Iodized Salt

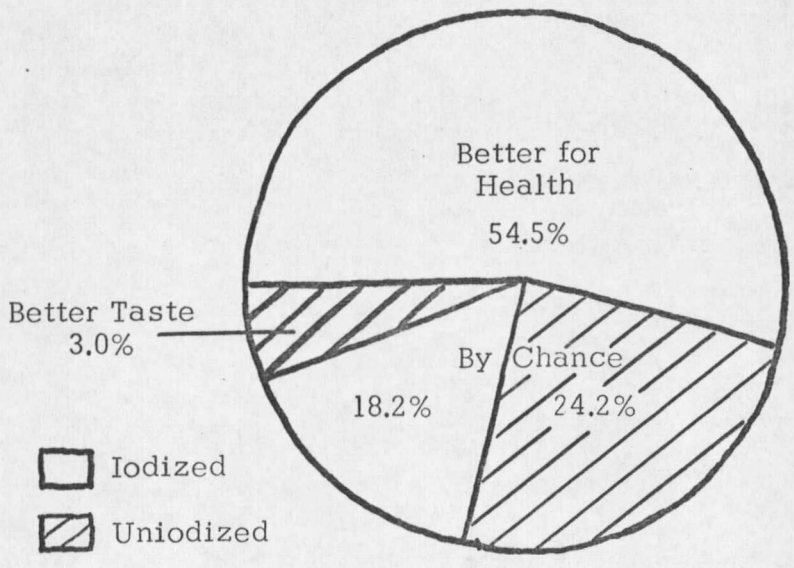


Figure 9--Reasons for Purchase of Type of Salt Used

members who bought salt, whether iodized or not, by picking up the first package they saw. Even though iodization of salt does not alter its taste (34), two respondents said iodized salt was too "salty", and one said iodized salt tasted better (Appendix D). One respondent also commented that she could not use iodized salt when canning. There were no respondents that indicated price was the reason for buying the salt they purchased, and results of the survey of grocery stores also pointed out a lack of price difference between the two types of salt. Respondents of a survey (58) in 1952 said uniodized salt was used because iodized salt was "bad" for skin diseases, especially acne. The American Dermatological Society has stated that iodized salt does not increase a tendency towards acne (58).

If compulsory salt iodization cannot be instituted, education may aid in increased iodized salt usage by the consumer. Many of the survey respondents realized iodized salt was "better" for their health, but they did not know why, so there is a question as to whether or not they would pass on their "knowledge" to their children correctly. The existence of fallacies concerning the detrimental effects of iodized salt, despite published statements to the contrary, also points out a need for education, as does the large percentage of consumers who buy salt by picking up the first package they see. In a discussion of iodized salt usage, Kimball said that ". . . education seems to last only a few years, and each generation has to be told again" (43: 81).

When asked about their source of knowledge concerning the use of iodized salt, most often (43.6% of the time) respondents replied that their mothers were their source of information (Table 2). Even if all school grades are put into one category, mothers would have a small margin over education (43.6% and 40.0%, respectively) as the major source of information. No matter what the source was, the interviewer informally noted that information concerning iodized salt usage was very vague. If the respondents said they knew iodized salt was better for them, they did not know why it was beneficial.

When an educational campaign is in the planning stage, it is helpful to know who should be the targets of the publicity. If publicity was directed at mothers and schools were asked to participate in the campaign, a large segment of the population should be reached. It has been suggested (58) that State Departments of Health, and medical and paramedical societies could educate with news articles, placards and health talks. These methods could perhaps be geared to mothers by: (1) putting articles in national magazines read by housewives; (2) placing placards in grocery stores; (3) presenting health talks to adult organizations; and (4) using radio programs aimed at the housewife. The school as a source of knowledge could be used by giving grade-school children a simple talk on iodized salt, and giving them a leaflet to take home to their mothers.

TABLE 2

RESPONDENTS' SOURCE OF KNOWLEDGE
ABOUT IODIZED SALT

Source of Knowledge	Respondents No.	%
Grade and Junior High School	5	9.1
High School	12	21.8
University	5	9.1
Mother	24	43.6
Husband	3	5.4
Other*	6	10.9

*Includes one from each of the following sources: magazine, book, other relative, physician, Peace Corps, and one "don't know".

The two large grocery stores that were surveyed sold three times as much iodized salt as uniodized. Two of the smaller stores sold twice as much iodized salt. The other smaller store, which is close to the University's married student housing, sold four times as much iodized salt as uniodized salt. The average ratio of iodized to uniodized salt sales is, therefore, 2.75:1. Using this ratio, expected usage of iodized salt would be 73.4% to 26.7% for uniodized salt. These figures are very close to the percentages obtained by the survey of households (72.7% and 27.3%).

Results of a recent survey (59) of a major grocery-store chain with outlets in most Montana communities showed a 2:1 ratio of iodized table salt sales compared to uniodized table salt. The higher average ratio obtained by surveying Bozeman stores may be due to a possible higher educational level of Bozeman residents. The fact that the store closest to married student housing had the highest ratio seems to indicate that the married students may be more knowledgeable, or the store displays the iodized salt more prominently.

Fish Consumption

If fish was served in the sample households once a week or twice a month, ocean fish was usually used (Figure 10). When fish was served once a month or less, responses indicate that shellfish

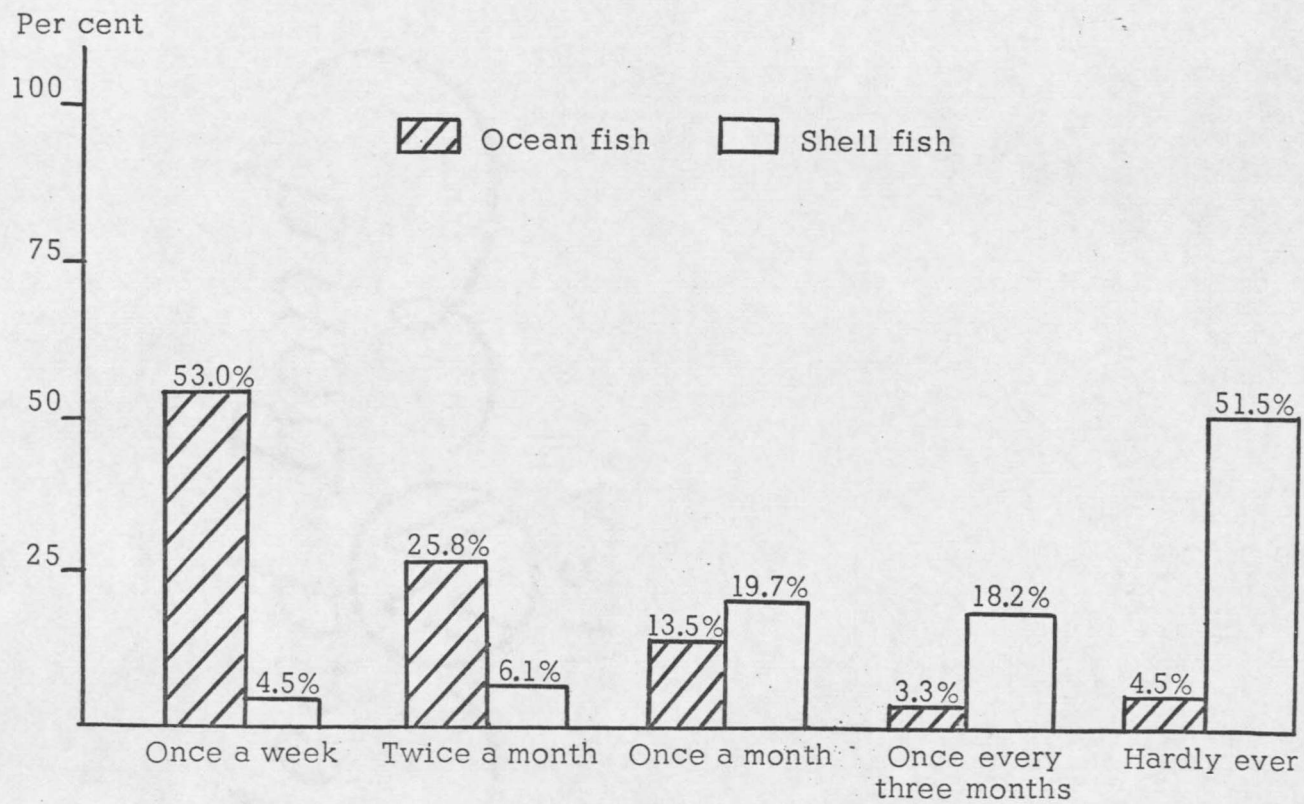


Figure 10--Percentage of Households Serving Fish at Various Frequencies

was the fish of choice. This may have been due to the cheaper price of marine fish, such as tuna, compared to shellfish.

A survey (42) of Ohio school children in 1955 revealed that if families served fish at least once a week, the percentage of goitrous children declined. If fish was eaten twice a month, the incidence of goitrous and non-goitrous children was even, and when the frequency of fish consumption was less than twice a month, the percentage of goitrous children rose. Table 3 contains a breakdown of the frequency of fish consumption in households using iodized and uniodized salt. There are five households, or one-third of those using uniodized salt, in the potentially dangerous situation of using uniodized salt and serving fish less than twice a month. This is 9.1% of the total sample.

TABLE 3
FREQUENCY FISH IS SERVED IN HOUSEHOLDS USING
IODIZED OR UNIODIZED SALT

	Iodized Salt		Uniodized Salt	
	No.	%	No.	%
Once a week	31	64.6	9	50.0
Twice a month	12	25.0	3	16.7
Less than twice a month	5	10.4	6	33.3

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary of Method and Results

The purpose of this pilot survey was to provide information on the use of major iodine sources by a select population, namely residents of married student housing at Montana State University, Bozeman, during June and July, 1970. A structured interview form was personally administered to a group of 66 randomly selected household members responsible for choosing the food their families purchased.

Most (83.3%) of the sampled families used salt only for cooking and at the table. If salt was used for canning food, uniodized salt was usually the type added. The percentage of families that were using iodized salt (72.7%) was lower by 12% than the most recent national average (85%).

Because "it is better for me and/or my family" was the reason 54.5% of the sample cited for the purchase of iodized salt. However, a large percentage (42.4%) of the iodized and uniodized salt was bought because it happened to be the first type that was seen by the purchaser. Fallacies that concern the type of salt to use, such as the better taste of iodized or uniodized salt, and the detrimental effect of adding iodized salt to food that is being canned, were found.

The highest percentage (43.6%) of interviewees indicated that their mothers were their source of information about the use of iodized salt. Schools (grade, junior high, high school and university) were a close second (40.0%) for the source of knowledge most often quoted to the interviewer.

Most of the respondents (83.3%) served marine or shellfish to their families at least twice a month. If fish was served at least twice a month, the greatest percentage of families served marine fish, especially tuna. The population of this survey had 9.1% of its households in a potentially dangerous position for goiter formation.

Conclusions

The data of this study indicate that an extensive goiter survey would be of value. The incidence of thyroid enlargement cannot be accurately measured by a survey of the use of iodine source: a medical survey of thyroid enlargement incidence must be conducted. It is only with the accurate information which a medical survey should provide that programs to increase iodized salt usage can be completely justified.

Compulsory iodization of salt would be the most efficient means of increasing iodine intake. However, an alternative would be education of the public, for the data of this survey indicate a great need for consumer education on the need and reasons for iodized salt usage.

Recommendations for Further Study

A more detailed study of methods of educating the consumer to buy iodized salt seems to be indicated. This study could include the possibilities previously mentioned, and the researcher should try to formulate some other ideas. Also, there is a need to know what organizations would cooperate with such a campaign: for example, professional groups concerned with health, grocery stores, schools, government agencies, and adult civic groups.

The need for an extensive goiter survey in Montana has been discussed. As the population used in the survey that has just been performed was limited, it would be helpful to conduct surveys of other population groups to find out if the best target populations for an educational campaign would be the same.

APPENDICES

APPENDIX A

SURVEY INTERVIEW QUESTIONNAIRE

Household Information

1. How old is the person in your household who usually buys the food?
 a) 10 to 15 years
 b) 16 to 20 years
 c) 21 to 25 years
 d) 26 to 30 years
 e) 31 to 40 years
 f) 41 to 50 years
 g) 51 to 60 years
 h) over 60 years
2. Are any members of your household eating mostly baby food and/or formula?
 a) Yes
 b) No
3. If so, do you ever add salt to their meals?
 a) Yes
 b) No
4. Is there anyone in your household on a low salt or low potassium diet?
 a) Yes
 b) No

Type of Salt Used

5. Does the package you use for table salt have the word IODIZED on the label?
 a) Yes
 b) No
6. Does the package you usually used for cooking salt have the word IODIZED on the label?
 a) Yes
 b) No

7. When you pickle food what kind of salt do you use?
- a) I don't pickle food
 - b) I use rock salt (pickling salt in large bags, usually)
 - c) I use iodized table salt
 - d) I use uniodized table salt
 - e) Other (please explain)
8. If any of the salt you use is IODIZED, why did you buy it?
- a) It is better for me and/or my family
 - b) It was the cheapest kind
 - c) It was the first package I saw
 - d) Other (please explain)
9. If the salt you are using is not IODIZED, why did you buy it?
- a) It is better for me and/or my family
 - b) It was the cheapest kind
 - c) It was the first package I saw
 - d) Other (please explain)
10. If you use uniodized salt, and you bought it because it was cheaper, would you buy iodized salt if the two were the same price?
- a) Yes
 - b) No
 - c) Don't know
11. Have you ever heard of using iodized salt before?
- a) Yes
 - b) No
 - c) Don't know
12. If so, when or from whom did you learn about it?
- a) grade school
 - b) junior high school
 - c) high school
 - d) university, or other higher learning institution
 - e) county extension agent
 - f) newspaper
 - g) magazine
 - h) book
 - i) mother
 - j) other relative
 - k) friend
 - l) don't know
 - m) other (please explain)

Other Sources of Iodine

13. How often do you serve ocean fish, such as cod, halibut, salmon, tuna, flounder, bass, haddock, perch, and snapper?

- a) Once a week
- b) Twice a month
- c) Once a month
- d) Once every three months
- e) Hardly ever
- f) Other (please explain)

14. How often do you serve shellfish, such as crab, shrimp, lobster, oysters, clams, or scallops?

- a) Once a week
- b) Twice a month
- c) Once a month
- d) Once every three months
- e) Hardly ever
- f) Other (please explain)

Comments

APPENDIX B

INTERVIEW ANSWER SHEET

1. _____ a)
_____ b)
_____ c)
_____ d)
_____ e)
_____ f)
_____ g)
_____ h)

2. _____ a)
_____ b)

3. _____ a)
_____ b)

4. _____ a)
_____ b)

5. _____ a)
_____ b)

6. _____ a)
_____ b)

7. _____ a)
_____ b)
_____ c)
_____ d)
_____ e) _____

8. _____ a)
_____ b)
_____ c)
_____ d) _____

9. _____ a)
_____ b)
_____ c)
_____ d) _____

10. _____ a)
_____ b)
_____ c)

11. _____ a)
_____ b)
_____ c)

12. _____ a)
_____ b)
_____ c)
_____ d)
_____ e)
_____ f)
_____ g)
_____ h)
_____ i)
_____ j)
_____ k)
_____ l)
_____ m) _____

13. _____ a)
_____ b)
_____ c)
_____ d)
_____ e)
_____ f) _____

14. _____ a)
_____ b)
_____ c)
_____ d)
_____ e)
_____ f) _____

Comments

APPENDIX C

LETTER OF INTRODUCTION

221 South Fifth Ave.
Bozeman, Montana 59715

June 4, 1970

Dear

I am a graduate student in Nutrition at MSU and would like to run a survey on the use of salt in this area. In order to get valid information and a representative sample, I am limiting my population to married student housing with the permission of the Housing Office.

Your household is one that I have chosen for my sample, so I would really appreciate your cooperation. I shall be calling on you within the next month to ask you a few questions that should not require more than ten minutes to answer. There are no wrong answers, and your name will not be available to anyone except myself. If I am unable to reach you in person I may be calling you on the telephone to arrange for a time to meet, convenient to you.

I look forward to making your acquaintance.

Sincerely,

S/
Betty Kay Jacobs (Mrs. Don)
Phone: 586-9143

APPENDIX D

TOTAL SAMPLE TALLY SHEET

1.	<u>9</u> a)		11.	<u>53</u> a)	
	<u>41</u> b)			<u>13</u> b)	
	<u>10</u> c)			<u> </u> c)	
	<u>2</u> d)	Total - 66	12.	<u>2</u> a)	
	<u>4</u> e)			<u>3</u> b)	
	<u> </u> f)			<u>12</u> c)	
	<u> </u> g)			<u>5</u> d)	
	<u> </u> h)			<u> </u> e)	
2.	<u>14</u> a)			<u> </u> f)	
	<u>52</u> b)			<u>1</u> g)	
3.	<u>3</u> a)			<u>1</u> h)	
	<u>11</u> b)			<u>24</u> i)	
4.	<u>8</u> a)			<u>1</u> j)	
	<u>58</u> b)			<u> </u> k)	
5.	<u>48</u> a)			<u>1</u> l)	
	<u>18</u> b)			<u>5</u> m)	<u>Husband - 3</u>
6.	<u>48</u> a)				<u>M.D. - 1</u>
	<u>18</u> b)				<u>Peace Corps - 1</u>
7.	<u>58</u> a)		13.	<u>35</u> a)	
	<u>4</u> b)			<u>17</u> b)	
	<u>2</u> c)			<u>9</u> c)	
	<u>2</u> d)			<u>2</u> d)	
	<u> </u> e)			<u>2</u> e)	
	<u> </u> f)			<u>1</u> f)	<u>Allergy</u>
8.	<u>36</u> a)		14.	<u>3</u> a)	
	<u> </u> b)			<u>4</u> b)	
	<u>12</u> c)			<u>13</u> c)	
	<u> </u> d)			<u>11</u> d)	
9.	<u> </u> a)			<u>34</u> e)	
	<u> </u> b)			<u>1</u> f)	
	<u>16</u> c)				
	<u>2</u> d)	<u>better taste (Iodized too salty)</u>			
10.	<u> </u> a)				
	<u> </u> b)				
	<u> </u> c)				

COMMENTS

Usually buys iodized - 2 (3.3%)

Uniodized for fish tank - 1

Uniodized for canning - 1

Iodized tastes better

APPENDIX E
TALLY SHEETS FOR AGE GROUPS

16-20 Years

1.	<u> </u> a) <u> x </u> b) <u> </u> c) <u> </u> d) <u> </u> e) <u> </u> f) <u> </u> g) <u> </u> h)	Total - 9	11.	<u> 7 </u> a) <u> 2 </u> b) <u> </u> c)
2.	<u> 2 </u> a) <u> 7 </u> b)		12.	<u> 1 </u> a) <u> </u> b) <u> 1 </u> c) <u> 1 </u> d) <u> </u> e) <u> </u> f) <u> </u> g) <u> </u> h) <u> 4 </u> i) <u> </u> j) <u> </u> k) <u> </u> l) <u> </u> m)
3.	<u> </u> a) <u> 2 </u> b)		13.	<u> 5 </u> a) <u> 3 </u> b) <u> 1 </u> c) <u> </u> d) <u> </u> e) <u> </u> f)
4.	<u> 3 </u> a) <u> 6 </u> b)		14.	<u> </u> a) <u> 1 </u> b) <u> 1 </u> c) <u> 2 </u> d) <u> 5 </u> e) <u> </u> f)
5.	<u> 7 </u> a) <u> 2 </u> b)			
6.	<u> 7 </u> a) <u> 2 </u> b)			
7.	<u> 9 </u> a) <u> </u> b) <u> </u> c) <u> </u> d) <u> </u> e)			
8.	<u> 6 </u> a) <u> </u> b) <u> 1 </u> c) <u> </u> d)			
9.	<u> </u> a) <u> </u> b) <u> 2 </u> c) <u> </u> d)			
10.	<u> </u> a) <u> </u> b) <u> </u> c)			

COMMENTS

21-25 Years

- | | |
|---|--|
| <p>1. <u> </u> a)
 <u> </u> b)
 <u> x </u> c)
 <u> </u> d) Total - 41
 <u> </u> e)
 <u> </u> f)
 <u> </u> g)
 <u> </u> h)</p> <p>2. <u> 11 </u> a)
 <u> 30 </u> b)</p> <p>3. <u> 2 </u> a)
 <u> 9 </u> b)</p> <p>4. <u> 5 </u> a)
 <u> 36 </u> b)</p> <p>5. <u> 30 </u> a)
 <u> 11 </u> b)</p> <p>6. <u> 30 </u> a)
 <u> 11 </u> b)</p> <p>7. <u> 39 </u> a)
 <u> 1 </u> b)
 <u> 1 </u> c)
 <u> </u> d)
 <u> </u> e) _____</p> <p>8. <u> 20 </u> a)
 <u> </u> b)
 <u> 10 </u> c)
 <u> </u> d) _____</p> <p>9. <u> </u> a)
 <u> </u> b)
 <u> 10 </u> c)
 <u> 1 </u> d) better taste _____</p> <p>10. <u> </u> a)
 <u> </u> b)
 <u> </u> c)</p> | <p>11. <u> 32 </u> a)
 <u> 9 </u> b)
 <u> </u> c)</p> <p>12. <u> 1 </u> a)
 <u> 3 </u> b)
 <u> 9 </u> c)
 <u> 4 </u> d)
 <u> </u> e)
 <u> </u> f)
 <u> </u> g)
 <u> </u> h)
 <u> 13 </u> i)
 <u> 1 </u> j)
 <u> </u> k)
 <u> 1 </u> l)
 <u> 2 </u> m) husband - 1
 <u> </u> Peace Corps - 1</p> <p>13. <u> 22 </u> a)
 <u> 11 </u> b)
 <u> 5 </u> c)
 <u> 2 </u> d)
 <u> 1 </u> e)
 <u> </u> f) _____</p> <p>14. <u> 2 </u> a)
 <u> 1 </u> b)
 <u> 8 </u> c)
 <u> 8 </u> d)
 <u> 22 </u> e)
 <u> </u> f) _____</p> <p>COMMENTS
 <u>Iodized tastes better - 1</u>
 <u>Usually buy iodized - 1</u>

 _____</p> |
|---|--|

26-30 Years

- | | | | |
|--|------------|--|--|
| 1. <u> </u> a)
<u> </u> b)
<u> </u> c)
<u> x </u> d)
<u> </u> e)
<u> </u> f)
<u> </u> g)
<u> </u> h) | Total - 10 | 11. <u> 8 </u> a)
<u> 2 </u> b)
<u> </u> c) | |
| 2. <u> 1 </u> a)
<u> 9 </u> b) | | 12. <u> </u> a)
<u> </u> b)
<u> 1 </u> c)
<u> </u> d)
<u> </u> e)
<u> </u> f)
<u> 1 </u> g)
<u> 1 </u> h)
<u> 4 </u> i)
<u> </u> j)
<u> </u> k)
<u> </u> l)
<u> 1 </u> m) <u>husband</u> | |
| 3. <u> 1 </u> a)
<u> </u> b) | | 13. <u> 3 </u> a)
<u> 3 </u> b)
<u> 2 </u> c)
<u> </u> d)
<u> 1 </u> e)
<u> 1 </u> f) <u>allergy</u> | |
| 4. <u> </u> a)
<u> 10 </u> b) | | 14. <u> 1 </u> a)
<u> 1 </u> b)
<u> 2 </u> c)
<u> 1 </u> d)
<u> 4 </u> e)
<u> 1 </u> f) <u>allergy</u> | |
| 5. <u> 6 </u> a)
<u> 4 </u> b) | | | |
| 6. <u> 6 </u> a)
<u> 4 </u> b) | | | |
| 7. <u> 6 </u> a)
<u> 2 </u> b)
<u> </u> c)
<u> 2 </u> d)
<u> </u> e) _____ | | | |
| 8. <u> 5 </u> a)
<u> </u> b)
<u> 1 </u> c)
<u> </u> d) _____ | | | |
| 9. <u> </u> a)
<u> </u> b)
<u> 4 </u> c)
<u> </u> d) _____ | | | COMMENTS
<u>Uniodized for fish tank - 1</u>
<u>Usually buys Iodized - 1</u>
<u>Uniodized for canning - 1</u>

_____ |
| 10. <u> </u> a)
<u> </u> b)
<u> </u> c) | | | |

31-50 Years

- | | | | | | |
|-----|-----------------|-----------------------|-----|-----------------|----------------------|
| 1. | <u> </u> a) | | 11. | <u> 6 </u> a) | |
| | <u> </u> b) | | | <u> </u> b) | |
| | <u> </u> c) | | | <u> </u> c) | |
| | <u> </u> d) | Total - 6 | | | |
| | <u> x </u> e) | | 12. | <u> </u> a) | |
| | <u> x </u> f) | | | <u> </u> b) | |
| | <u> </u> g) | | | <u> 1 </u> c) | |
| | <u> </u> h) | | | <u> </u> d) | |
| 22. | <u> </u> a) | | | <u> </u> e) | |
| | <u> 6 </u> b) | | | <u> </u> f) | |
| | | | | <u> </u> g) | |
| 3. | <u> </u> a) | | | <u> </u> h) | |
| | <u> </u> b) | | | <u> 3 </u> i) | |
| | | | | <u> </u> j) | |
| 4. | <u> </u> a) | | | <u> </u> k) | |
| | <u> 6 </u> b) | | | <u> </u> l) | |
| | | | | <u> 2 </u> m) | <u> M.D. - 1</u> |
| | | | | | <u> husband - 1</u> |
| 5. | <u> 5 </u> a) | | | | |
| | <u> 1 </u> b) | | 13. | <u> 5 </u> a) | |
| | | | | <u> </u> b) | |
| 6. | <u> 5 </u> a) | | | <u> 1 </u> c) | |
| | <u> 1 </u> b) | | | <u> </u> d) | |
| | | | | <u> </u> e) | |
| 7. | <u> 4 </u> a) | | | <u> </u> f) | |
| | <u> 1 </u> b) | | | | |
| | <u> 1 </u> c) | | 14. | <u> </u> a) | |
| | <u> </u> d) | | | <u> 1 </u> b) | |
| | <u> </u> e) | | | <u> 2 </u> c) | |
| | | | | <u> 1 </u> d) | |
| 8. | <u> 5 </u> a) | | | <u> 2 </u> e) | |
| | <u> </u> b) | | | <u> </u> f) | |
| | <u> </u> c) | | | | |
| | <u> </u> d) | | | | |
| | | | | | |
| 9. | <u> </u> a) | | | | |
| | <u> </u> b) | | | | |
| | <u> </u> c) | | | | |
| | <u> 1 </u> d) | <u> better taste</u> | | | |
| | | | | | |
| 10. | <u> </u> a) | | | | |
| | <u> </u> b) | | | | |
| | <u> </u> c) | | | | |

COMMENTS

LITERATURE CITED

- 1 Pitt-Rivers, R. and W. Trotter, eds. 1964. The Thyroid Gland. London: Butterworths, I: 1.
- 2 Schaefer, A. 1969. The national nutrition survey. J. Amer. Diet. Ass.: 54: 371.
- 3 Wilson, E., K. Fisher, and M. Fuqua. 1965. Principles of Nutrition. 2nd ed. New York: John Wiley and Sons, p. 165.
- 4 McClendon, J. 1939. Iodine and the Incidence of Goiter. Minneapolis: University of Minnesota Press.
- 5 Bourne, G. and G. Kidder, eds. 1953. Biochemistry and Physiology of Nutrition. New York: Academic Press, II: 427.
- 6 Sebrell, W. 1949. Iodine—a food essential. Pub. Health Rep. 64: 1075.
- 7 Pitt-Rivers, R. and W. Trotter, eds. I: 71.
- 8 Ibid., I: 87.
- 9 Hazard, J. and D. Smith, eds. 1964. The Thyroid. Baltimore: Williams and Wilkins, p. 58.
- 10 Ibid., p. 49.
- 11 Deiss, W. 1962. Transport of the thyroid hormones. Fed. Proc., Amer. Soc. Exp. Biol. 21: 630.
- 12 Albert, A. and F. Keating. 1952. The role of the gastrointestinal tract, including the liver, in the metabolism of radiothyroxine. Endocrinology, 51: 427.
- 13 Pitt-Rivers, R. and W. Trotter, eds. I: 163.
- 14 Ibid., I: 237.

- 15 Kimball, O. 1923. The prevention of simple goiter. Pub. Health Rep. 38: 877.
- 16 Pitt-Rivers, R. and W. Trotter, eds. I: 187.
- 17 Greer, M. 1960. The significance of naturally occurring anti-thyroid compounds in the production of goiter in man. Borden's Rev. Nutr. Res. 21: 61.
- 18 Malamos, B., D. Koutras, S. Marketos, G. Rigopoulos, X. Yataganas, D. Binopoulos, J. Sfontouris, S. Pharmakiotis, R. Vought, and W. London. 1967. Endemic goiter in Greece: an iodine balance study in the field. J. of Clin. Endocrinol. Metab. 27: 1372.
- 19 Pitt-Rivers, R. and W. Trotter, eds. II: 71.
- 20 Hazard, J. and D. Smith, eds. p. 100.
- 21 Mrine, D. 1933. The importance of relative iodine deficiencies in certain forms of goiter. J. Amer. Diet. Ass. 9: 1.
- 22 Blum, F. 1941. Studies in goiter: iodine deficiency or goiter inducive agent. Schweiz. Med. Wochschr. 71: 1612. Abstracted in Bibliography of the Literature on the Minor Elements and their Relation to Plant and Animal Nutrition. 1948. New York: Chilean Nitrate Educational Bureau. Vol. I.
- 23 Clements, F. and J. Wishart. 1956. A thyroid-blocking agent in the etiology of endemic goiter. Metab. Clin. Exp. 5: 623.
- 24 Kaunitz, H. and R. Johnson. 1967. Thyroid and pituitary pathology in iodine-deficient rats fed fresh and oxidized fats and oils. J. Nutr. 91: 55.

- 25 Greer, M. and E. Astwood. 1948. The antithyroid effect of certain foods in man as determined with radioactive iodine. *Endocrinology*, 42: 105.
- 26 Srinwasan, V., N. Moudgal, and P. Sarma. 1957. Studies on goitrogenic agents in food. I: Goitrogenic action of the groundnut. *J. Nutr.* 61: 87.
- 27 Marine, D. 1926. Simple goiter and its prevention. *J. Amer. Med. Ass.* 87: 1463.
- 28 Demarchi, M., A. Al-Hindawi, M. Abdalnabi, and H. Taj El-Din. 1969. Prevalence and etiology of goiter in Iraq. *Amer. J. Clin. Nutr.* 22: 1660.
- 29 Davenport, C. 1932. *The Genetical Factor in Endemic Goiter.* Carnegie Institute of Washington, Publication 428.
- 30 Olesen, R. 1926. Distribution of endemic goiter in the United States as shown by thyroid surveys. *Pub. Health Rep.* 41: 2691.
- 31 Olesen, R. 1929. Distribution of endemic goiter in the United States as shown by thyroid surveys. *Pub. Health Rep.* 44: 1463.
- 32 Astwood, E. 1955. Iodine in nutrition. *Borden's Rev. Nutr. Res.* 16: 53.
- 33 Curtis, O. and M. Fertman. 1949. Iodine in nutrition. *J. Amer. Med. Ass.* 139: 28.
- 34 Hirschfelder, A. 1922. A simple method for administration of iodide in the food in goitrous regions. *J. Amer. Med. Ass.* 79: 1426.

- 35 Olin, R. 1924. Iodine deficiency and prevalence of simple goiter in Michigan. *J. Amer. Med. Ass.* 82: 1328.
- 36 Sherman, H. 1924. Iodine in nutrition; goiter as a nutritional problem. *Amer. J. Pub. Health*, 14: 1038.
- 37 Kimball, O. 1928. The efficiency and safety of the prevention of goiter. *J. Amer. Med. Ass.* 91: 454.
- 38 Johnson, F. and E. Frederick. 1940. Stabilization of iodine in salt and feedstuffs. *Science*, 92: 315.
- 39 Emami, A., H. Shahbazi, M. Sabzevari, Z. Gawam, N. Sarkissian, and P. Hamedi. 1969. Goiter in Iran. *Amer. J. Clin. Nutr.* 22: 1584.
- 40 Olesen, R. 1924. Methods of administering iodine for prophylaxis of endemic goiter. *Pub. Health Rep.* 39: 45.
- 41 Buttfield, I. 1965. Correction of iodine deficiency in New Guinea natives by iodized oil injection. *Lancet*, 2: 767.
- 42 Hamwi, G., A. Van Fossen, R. Whetstone, and I. Williams. 1955. Endemic goiter in Ohio school children. *Amer. J. Pub. Health*, 45: 1344.
- 43 Kimball, O. 1946. Iodized salt for the prophylaxis of endemic goiter. *J. Amer. Med. Ass.* 130: 80.
- 44 Gaitan, E., H. Wahner, P. Correa, R. Bernal, W. Jubiz, J. Gaitan, and G. Llanos. 1968. Endemic goiter in the Cauca Valley: I. Results and limitations of twelve years of iodine prophylaxis. *J. of Clin. Endocrinol. Metab.* 28: 1730.
- 45 Kovaly, K. 1970. Cancer linked to deficiency of iodine in food. *Biomedical News*, May, p. 1.

- 46 Hartsock, C. 1926. Iodized salt in the prevention of goiter. *J. Amer. Med. Ass.* 86: 1334.
- 47 Morgans, M. and W. Trotter. 1953. Two cases of myxoedema attributed to iodide administration. *Lancet*, 2: 1335.
- 48 Socolow, E., D. Dunlap, R. Sobel, and S. Ingbar. 1968. A correlative study of the effect of iodide administration in the rat on thyroidal iodide transport and organic iodine content. *Endocrinology*, 83: 737.
- 49 Yamamoto, Y., S. Moriya, and V. Horiuchi. 1969. Iodide outflow from thyroid: its relation to plasma inorganic iodide concentration. *J. of Clin. Endocrinol. Metab.* 29: 265.
- 50 Vought, R. and W. London. 1967. Iodine intake, excretion and thyroidal accumulation in healthy subjects. *J. of Clin. Endocrinol. Metab.* 27: 913.
- 51 Malvaux, P., C. Beckers, and M. DeVisscher. 1969. Iodine balance studies in nongoitrous children and in adolescents on low iodine intake. *J. of Clin. Endocrinol. Metab.* 29: 79.
- 52 Dworkin, H., J. Jacquez, and W. Beierwaltes. 1966. Relationship of iodine ingestion to iodine excretion in pregnancy. *J. of Clin. Endocrinol. Metab.* 26: 1329.
- 53 Food and Nutrition Board, National Academy of Sciences—National Research Council. 1968. Recommended Dietary Allowances. 7th ed. Washington, D.C.: National Academy of Sciences, Publication 1694.
- 54 Middleton, G. 1925. Goiter in the intermountain region of Utah. *J. Amer. Med. Ass.* 84: 1172.

- 55 Jarvis, N., R. Clough, and E. Clark. 1926. Salmon in a diet for the prophylaxis of goiter. *J. Amer. Med. Ass.* 86: 1339.
- 56 Vought, R. and W. London. 1964. Dietary sources of iodine. *Amer. J. Clin. Nutr.* 14: 186.
- 57 Consumer and Food Economics Research Division. 1969. Salt purchases by families. *Family Economics Review, Publication ARS 62-5, U.S.D.A., December, p. 12.*
- 58 Brush, B. and J. Altland. 1952. Goiter prevention with iodized salt: results of a thirty-year study. *J. of Clin. Endocrinol. Metab.* 12: 1380.
- 59 Depew, D. 1969. Your child's health: use of iodized salt is preventive medicine. *Hardin Tribune-Herald, Hardin, Montana, December 6.*

MONTANA STATE UNIVERSITY LIBRARIES



3 1762 10014553 9

7.378
J148
Cop. 2



X